Flight in Icing Conditions Manual

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F-dgac

FIC Manual

- Availability in two formats :
  -complete version
  -summary
- At the used of :
  -pilots for training and recurrent training
  -type rating courses...

FIC Manual Content

- What is ice? Meteorological factors
- Ice accretion, detection and protection
- Effect of ice on aircraft
- Aircraft operation

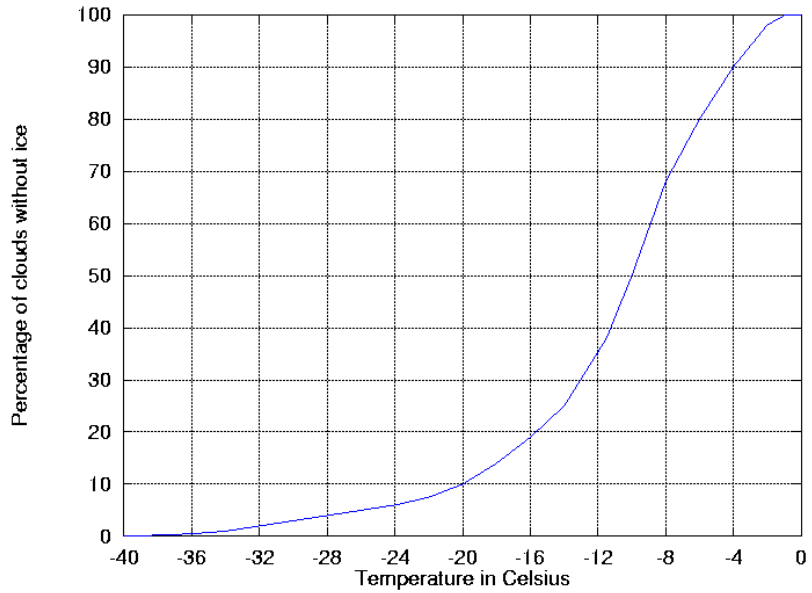
Meteorological Factors

- Water droplets clouds
- Temperatures
- SLD formation
- Icing phenomenon

Fig. 2.3) Cumulus congestus **Fig. 2.4) Cumulonimbus calvus precipitation** **Fig. 2.5) Cumuloninbus capillatus incus**

Meteorological Factors

- Water droplets clouds
- Temperatures
- SLD formation
- Icing phenomenon



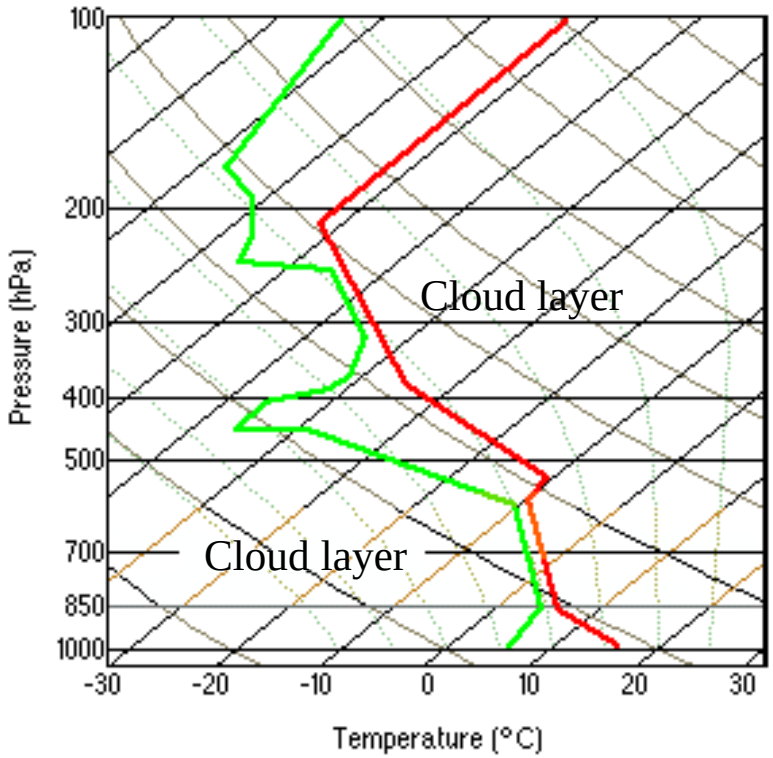


Fig. 2.1) Frequency of ice crystal in clouds

Fig. 2.2) Skew-T diagram

Meteorological Factors

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Two mechanisms can cause SLD formation:

1) Thermal inversion

2) Collision coalescence phenomenon

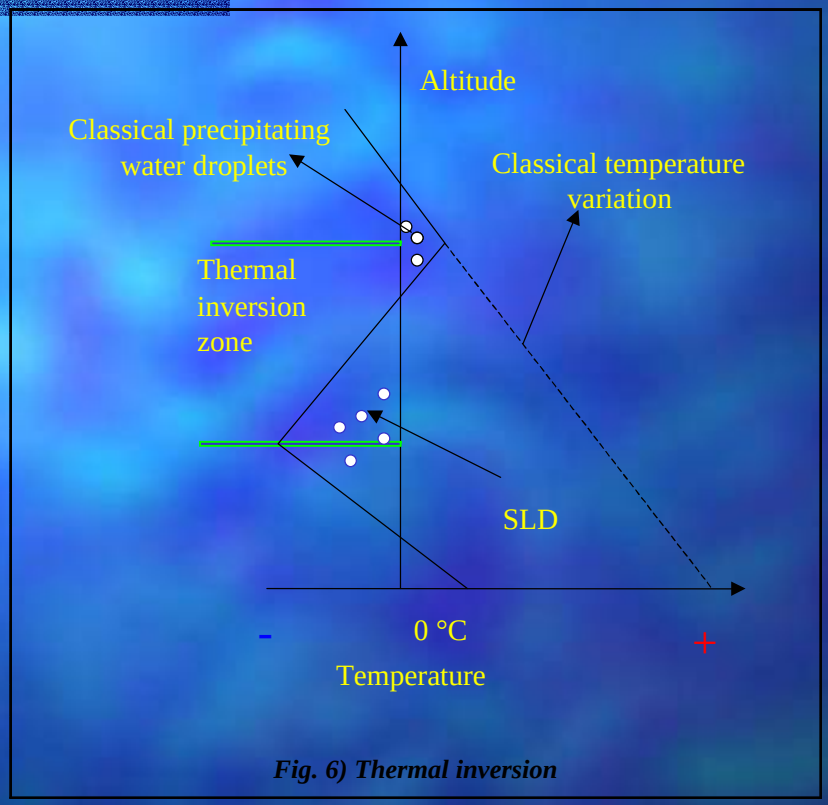

Fig. 6) Thermal inversion

Meteorological Factors

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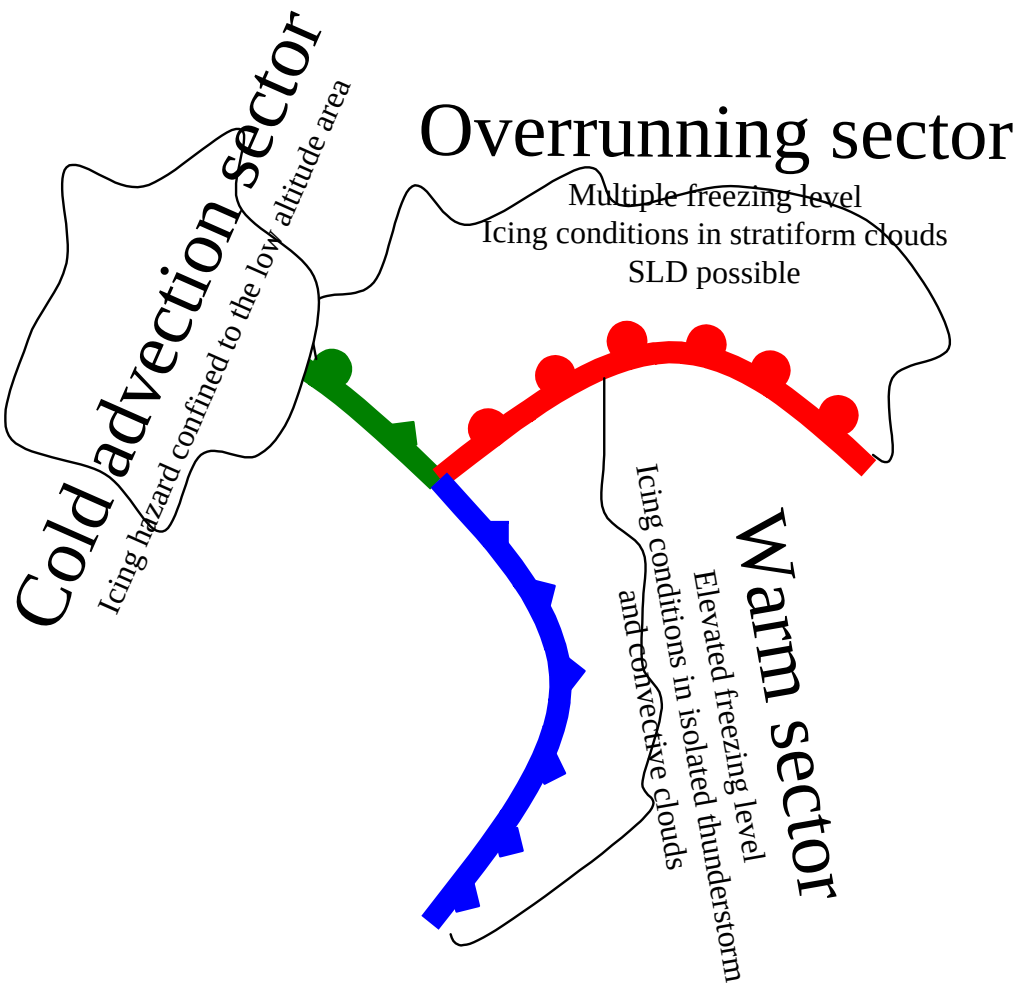

Fig. 2.11) Cyclone

Ice Accretion

- Droplets trajectories
- Rime ice
- Glaze ice
- Residual ice shape after de icing

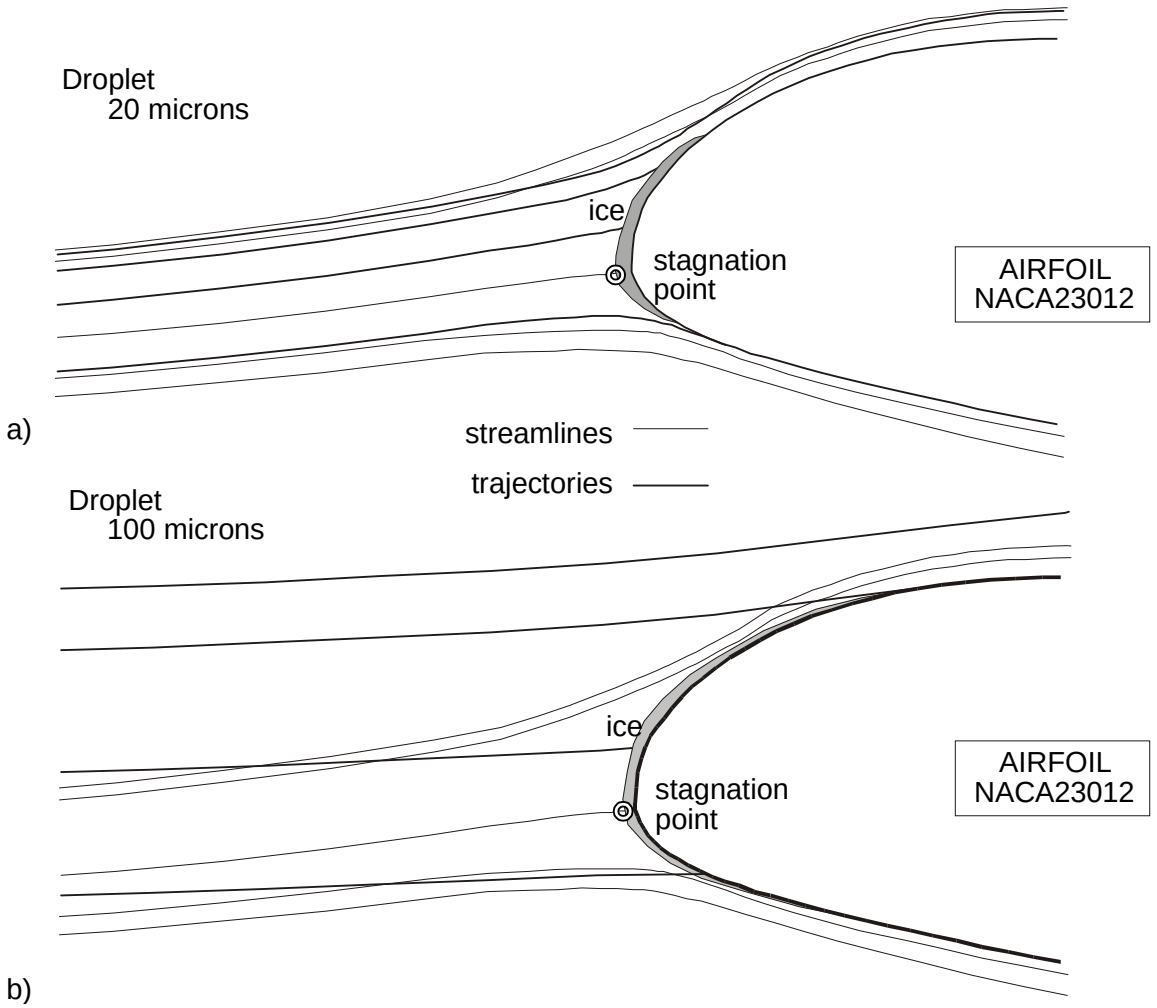

Fig. 3.2-a) Droplets trajectories, diameter 20 microns, NACA 23012 airfoil;
Fig.3.2-b) Droplets trajectories, diameter 100 microns, NACA 23012 airfoil.

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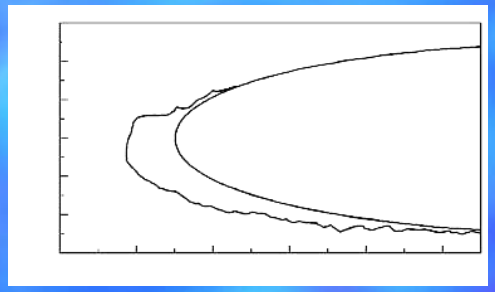
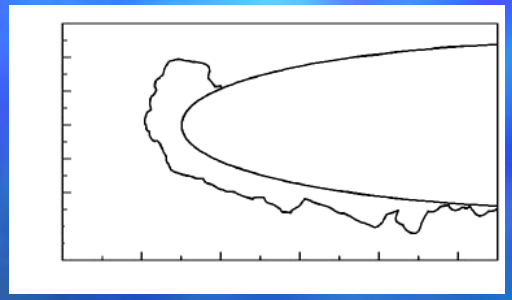
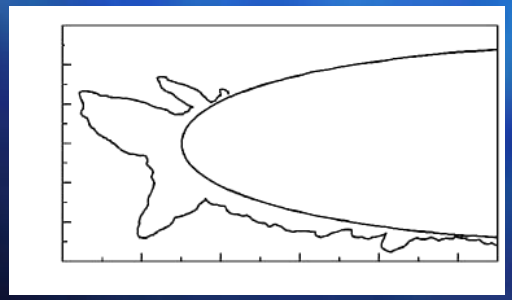


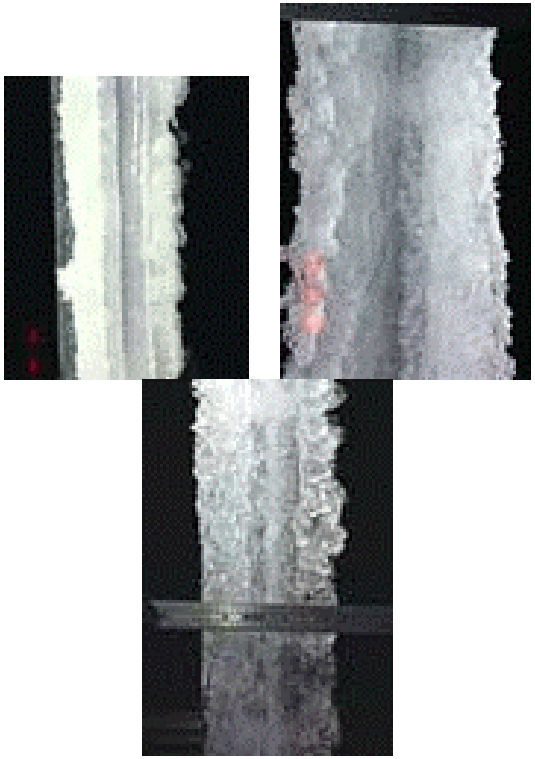
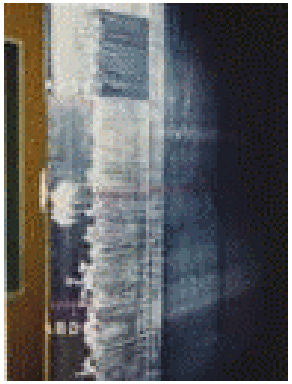
Rime ice



Glaze ice (single horn)



Glaze ice (double horns)

Glaze and mixed ice	Rime ice	Run-back ice
		

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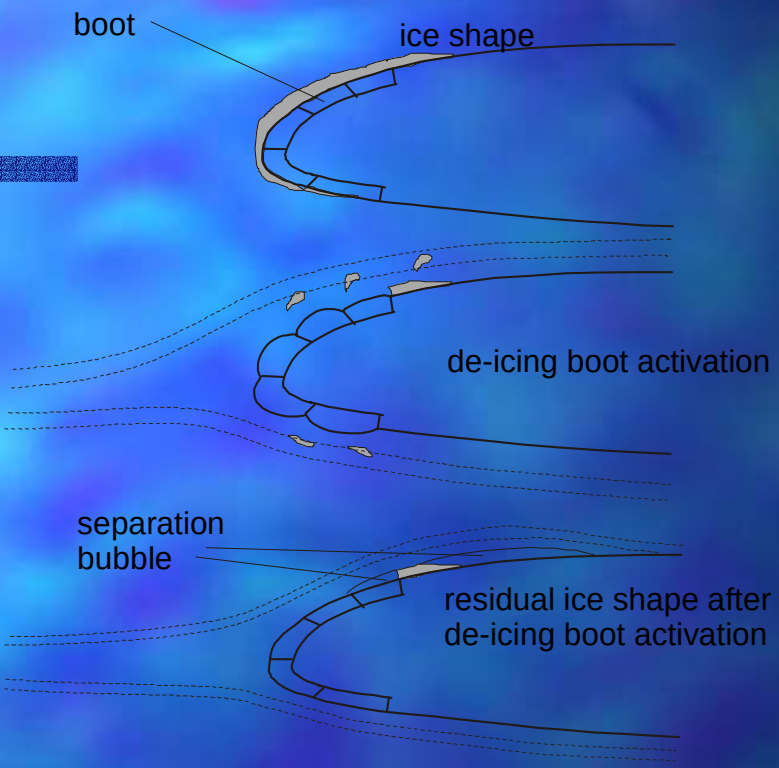

Fig. 4.13) Effect of de-icing boot activation in presence of ice formations beyond the commonly protected airfoil zones.

Ice Detection

- Flight crew is responsible for monitoring the presence of ice
- Automatic detection
- Manual detection

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5.1) Visual cues
5.2) Detection of icing condition
5.3) Detection of ice accretion
5.4) Aerodynamics performance monitoring
5.5) Visualization on of surfaces
5.6) Remote detection of icing conditions
5.7) Detection beyond Appendix C
5.8) Ground icing detection
5.9) Other

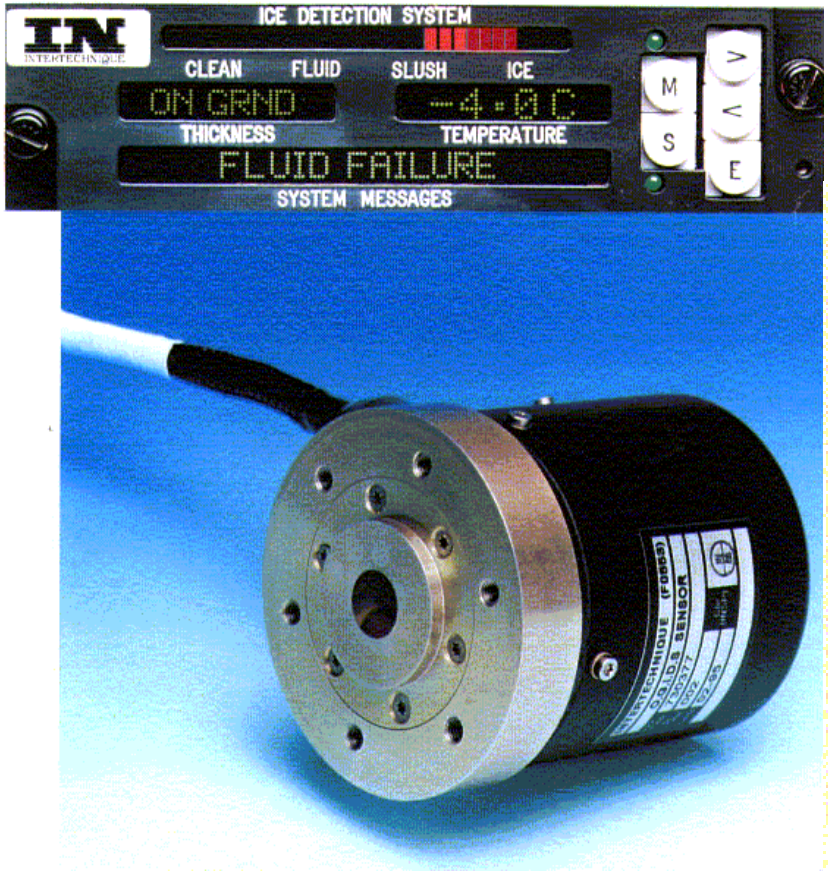


Fig. Non-intrusive ice detector

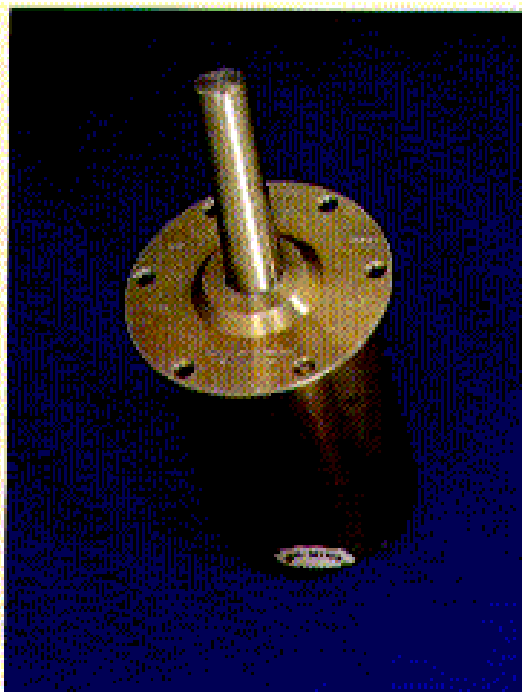
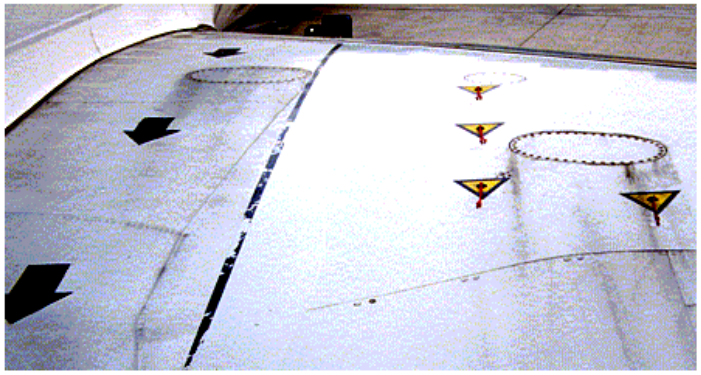


Fig. Intrusive ice detector



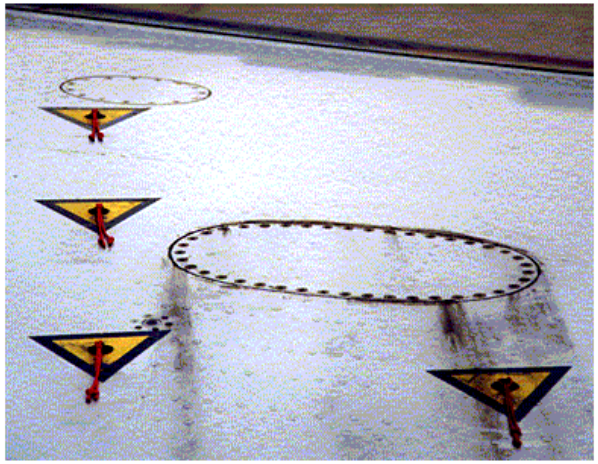


Fig. Tufts used for ground icing detection

Ice Protection

- Ground anti-icing fluids
- In-flight protection
  -pneumatic boot de-icing
  -thermal ice protection
  -electrothermal ice protection

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Fig. Example of ground ice treatment

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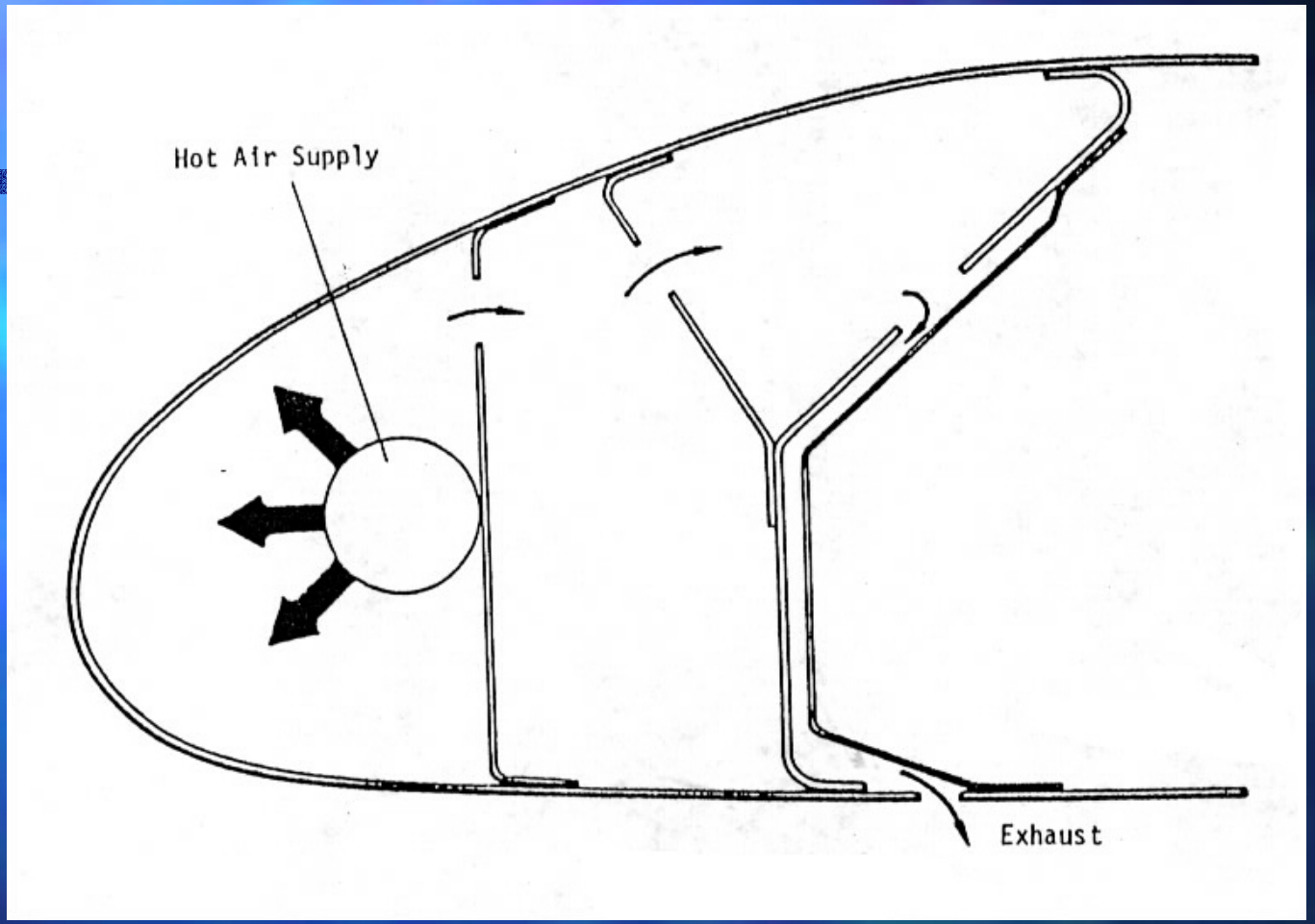

Fig. Thermal (Bleed Air) Ice Protection

Aerodynamics Degradations

- Lift reduction
- Stall angle reduction
- Drag increase
- Longitudinal and lateral stability
- Loss of effectiveness of control surfaces

Effect of Ice on Aircraft (1/2)

- Wing stall
- Icing contaminated tail stall
- Icing contaminated roll upset
- Ground icing
- Engine and induction icing

Effect of Ice on Aircraft (2/2)

- Carburator icing
- Propeller icing
- Instrument icing
- Windshield

Contain in operational description

- Description
- Identification
- Avoidance
- Recovery

Aircraft Operation

- Weather analysis
- Pre-flight
- Taxiing
- Take-off
- Climb out
- Cruise
- Descent
- Approach and landing

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8.4) Take-off

NOTE: THIS PHASE INCLUDES THE CONSIDERATIONS THAT ARE USUALLY MADE BELOW 1500 FEET. FOR PISTON ENGINE SUCH PHASE WILL LAST UNTIL TAKE-OFF POWER IS APPLIED.

1. WEATHER RADAR	SWITCH ON THE WEATHER RADAR AND ASSESS THE SITUATION;
2. ICE PROTECTION SYSTEM	ARM OR MAKE SURE THE AIRCRAFT ICE PROTECTION SYSTEMS ARE ON;
3. TAKE-OFF SPEED	IF APPLICABLE, CONSIDER INCREASED TAKE-OFF SPEEDS;
4. ENGINE IGNITION	PLACE THE ENGINE IGNITION ON;
5. STATIC TAKE-OFF	PERFORM A STATIC TAKE-OFF; the aircraft manual will provide specific indications;
6. ENGINE PERFORMANCES	CHECK ENGINE PERFORMANCE and MINIMUM ENGINE SPEED DURING THE TAKE-OFF ROLL;
7. CARBURETOR HEAT SYSTEM (if applicable)	TAKE OFF WITH THE CARBURETOR HEAT SYSTEM OFF;
8. LANDING GEAR	CONSIDER RECYCLING THE LANDING GEAR.

Typical Ice Accident

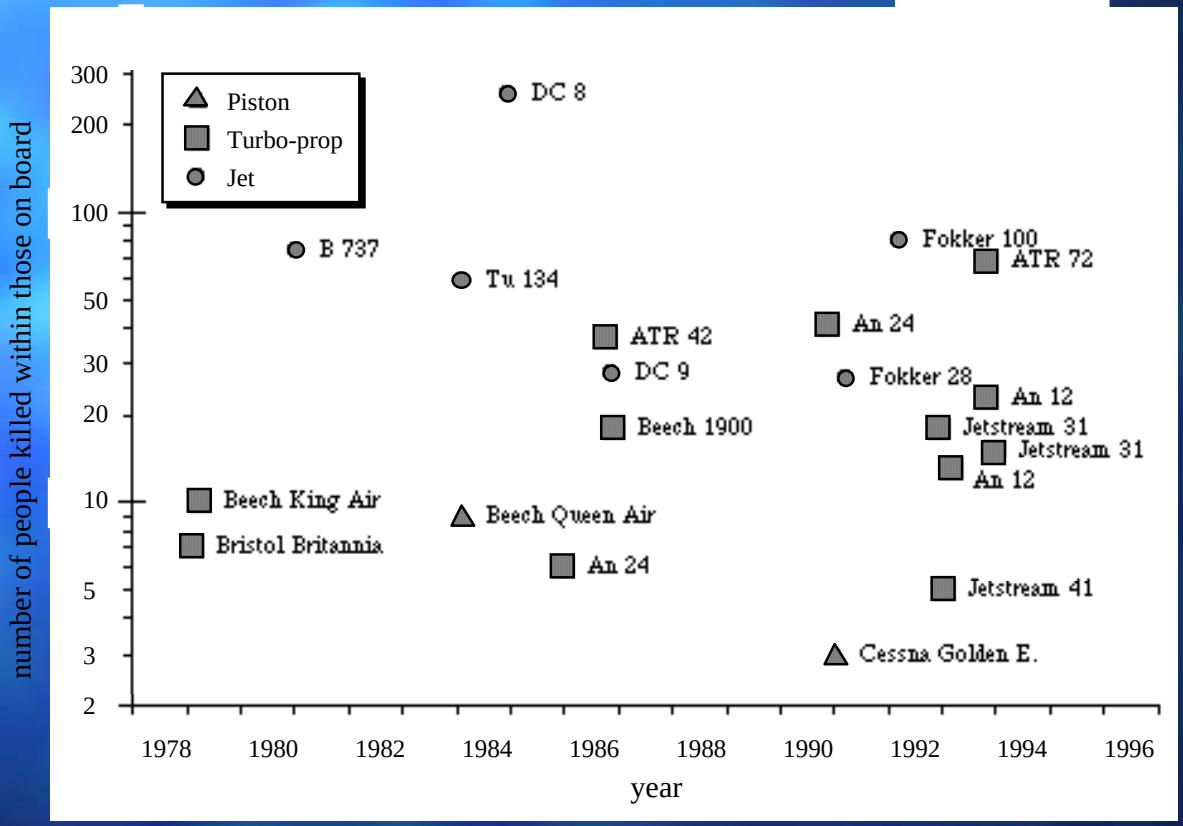

Fig. Fatal accidents caused by icing concerning aircraft with more than 7 people on board since 1978

Conclusion

- This manual contains all the information required and useful for the pilot flying in icing conditions as well as for the ground icing than for the in-flight icing.
- This manual is also a good help for the different training during the pilot working life

Conclusion

- The summary is useful for the pilot to remember his knowledge on the icing condition
- The summary is easy to manipulate
- They are both available in english version